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Abstract

We develop a theoretical model regarding the migration of dual-earner couples and test it in the context of international migration. Our model predicts that the probability that a couple emigrates increases with the income of the primary earner, whereas the income of the secondary earner may affect the decision in either direction. We conduct an empirical analysis that uses population-wide administrative data from Denmark, and the results are consistent with our model. We find that primary earners in couples are more strongly self-selected with respect to income than single persons. This novel result counters the intuition that family ties weaken self-selection.

JEL Codes: F22; J12; J16; J24

Keywords: International migration; Family migration; Education; Gender differences; Dual-earner couples

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I. Introduction

Couples are less likely to migrate than single persons, even after controlling for age. An important explanation for this behavior pattern is that a dual-career couple considering migration may face difficulties in finding good employment matches for both partners in the same location. In pioneering contributions, Mincer (1978) and Frank (1978a, 1978b) linked couples' colocation problems with lower earnings by women. If migration decisions are made to maximize joint family incomes and women initially earn less than men, migration decisions will thus disadvantage women even further. Costa and Kahn (2000) concluded that the colocation problem is the primary explanation for why college-educated couples in the United States have increasingly chosen to live in large metropolitan areas after the Second World War.

In this paper, we examine the international migration of couples. First, we develop a theoretical model for migration decisions made by dual-earner couples, and then we analyze how the probability of couples migrating depends on the home-country earnings of either the higher or lower earning partner. Our theoretical model predicts that the likelihood that a couple migrates increases with the primary earner's home-country income, whereas the secondary earner's home-country income may affect the decision in either direction. Although Mincer (1978) previously developed a model for the general idea that a couple migrates when the sum of the partners' gains exceeds the sum of the migration costs, our model is the first to analyze whether the probability that a couple migrates depends on the earnings of the primary and secondary earners when the job opportunities in the destination country have individual-specific components. This theoretical model can be used to analyze both internal and international migration. The model predicts that primary earners in couples are more strongly self-selected with respect to their income than single persons, whereas secondary earners are more weakly self-selected.

We test our model using register data from Denmark, which is one of the richest and most gender-equal countries in the world (Klugman 2011). Analyzing data from Denmark is advantageous because of the availability of exceptionally high-quality register data. Our analysis includes data regarding the entire Danish population from 1982 to 2010, including age, gender, and household identifiers that allow us to identify cohabiting couples, as well as the educational attainment, income levels and migration events of all Danes registered to live in Denmark. Restricting our analysis to dual-earner couples in which both partners worked for most of the year and are between 25 and 37 years of age yields more than 500,000 couple-year observations in which the female is the primary earner and more than

2.6 million couple-year observations in which the male is the primary earner. We restrict our attention to male-female couples due to the difficulty of recognizing cohabiting same-sex couples in the data. Following Costa and Kahn (2000), couples in which both the male and female partners have college educations are referred to as power couples, and couples in which neither partner has a college education will be referred to as low-power couples. In male-power couples, the male partner has a college education (but the female partner does not), whereas in female-power couples, only the female partner has a college education.

Although there is a large body of literature addressing family migration in the national context, our study is the first to analyze couple migrations separately for couples in which men earn more compared with those couples in which women earn more. This comparison allows us to test two competing hypotheses throughout our analysis. The first hypothesis embodies the traditional male breadwinner model: migration is more strongly influenced by the educational attainment and earnings of the male partner. The second (alternative) hypothesis is that family migration from Denmark is influenced more strongly by the better educated or higher earning spouse's job opportunities. The previous literature regarding internal migration has supported the male breadwinner model. However, as a group, Danish women have been better educated than Danish men since the 1990s, and the participation rate of the female labor force in Denmark surpassed 70% in the 1980s. To distinguish the effects of earnings from the effects of education, we analyze couples belonging to different power types separately.

If family migration patterns are traditional and are dominated by male job opportunities, we would expect that the probability of emigration would increase with male earnings, regardless of both a couple's power type and which partner earned more prior to migration. Our competing hypothesis is that migration is influenced by the higher earning spouse's job opportunities, which suggest that male earnings play a bigger role in couples in which the male earns more and female earnings play a bigger role in couples in which the female earns more.

Our main empirical finding is that the probability that a dual-earner couple emigrates increases with the earnings of the higher earning partner, regardless of whether the primary earner is male or female. The effect of the secondary earner's income varies and is generally much weaker than that of the primary earner's. After separately deriving the effects of the primary and secondary earners' incomes using a probit model for low-power couples, female-power couples, male-power couples and power couples, we investigate whether the elasticity of the probability of emigration with respect to earnings (henceforth, the elasticity

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of migration) differs between single persons and primary and secondary earners in couples. Knowing the elasticity of migration with respect to earnings for single persons and primary and secondary earners in couples allows us to evaluate the importance of the role that family ties play in migrants' self-selection. We find very high elasticities with respect to the primary earner's income. For couples with a female (male) primary earner, the elasticity of migration for five or more years with respect to the female's (male's) income varies between 1.4 (2.5) and 3.3 (3.1). These elasticities are considerably larger than those for single persons. The elasticity of migration with respect to income is 1.1 for college-educated single men and 1.0 for single men with no college education. The elasticity is 0.9 for college-educated single women and 0.2 for single women without a college education.

Our findings suggest that the self-selection of primary earners in emigrating couples from Denmark is, if anything, stronger than the self-selection of emigrating single persons. This finding contrasts with the results from Borjas and Bronars (1991), who conclude that self-selection of migrants moving to the United States with their partners is not as strong with respect to individual characteristics as the self-selection of single migrants. The elasticities of the secondary earners are generally small, and sometimes negative, which reflects the colocation problem. Therefore, family ties appear to have opposing effects for primary and secondary earners, strengthening self-selection with respect to the primary earner's income and weakening self-selection with respect to the secondary earner's income. The results are qualitatively similar when the focus is restricted to couples and single persons without children, as this segregates the colocation problem from the effects of having children.

We also find that couples' migration from Denmark is more responsive to the male's education than to the female's education. Even among couples in which the female earned more, the emigration rate of male power couples is higher than that of female power couples. Power couples are the most likely to emigrate but also the most likely to return. Couples in which only the male is college educated are more than twice as likely to emigrate than couples in which only the female is college educated.

For simplicity, our model abstracts from differences in average returns to skill between the origin and destination countries. Since the pioneering analysis by Borjas (1987), it is generally understood that such differences play an important role in the self-selection of emigrants. Interestingly, Grogger and Hanson (2011) found that international labor movements tend to be characterized by two stylized facts. First, more educated persons are more likely to emigrate internationally (i.e., positive self-selection). Second, the more educated migrants are more likely to settle in destination countries with high returns to skill (i.e.,

positive sorting). This last stylized fact suggests that omitting differences in returns to skill is not a major problem for our main empirical analysis because our focus is on the self-selection of emigrants and not on their sorting across different destinations. Furthermore, the skill price differences should not influence our comparisons between single persons and couples because these differences affect both groups. Nonetheless, we also separately analyze migration to different destinations. This analysis suggests that our qualitative results hold with regard to migration to other Nordic countries with similar skill prices as Denmark. The elasticity of migration with respect to earnings is larger for migration to other destinations, which is consistent with the Roy-Borjas model (Roy 1951; Borjas 1987). To address the concern that immigration rules in potential destination countries might be driving our results, we separately analyze migration to the United Kingdom and Ireland (countries into which Danes can migrate freely due to joint membership in the European Union) and migration to the United States, Canada, Australia, and New Zealand (countries with immigration rules that impose additional restrictions). Our results hold for both destination groups.

Related literature. Migration research has a long tradition in economics. Adam Smith discussed the persistence of wage differences among different locations in the United Kingdom in *An Inquiry into the Nature and Causes of the Wealth of Nations* and concluded that "a man is of all sorts of luggage the most difficult to be transported." Sjaastad (1962) made a connection between migration and investment in human capital and argued that the prospective migrant should choose the destination that maximizes the net present value of his/her lifetime earnings, net of migration costs. Mincer (1978) and Frank (1978a, 1978b) extended the same logic to couple migration. However, these authors did not analyze whether the probability of migration depends on the pre-migration incomes of the primary and secondary earners. Subsequently, Mont (1989) showed that a couple may choose a location that is not optimal for either partner. Borjas and Bronars (1991) concluded that family ties weaken migrants' self-selection. A key difference in our model is that Borjas and Bronars assumed that income prospects are perfectly correlated across home and potential destination countries. In our model, both the primary and secondary earners face an individual-specific realization of earnings opportunities abroad. Therefore, our model allows for the possibility that a secondary earner may gain from migration and the primary earner may lose and that the roles of the secondary and primary earners may thus be reversed, at least when initial income differences are not too great.

In a theoretical contribution to the joint job search literature, Guler et al. (2012) concluded that if ex ante identical spouses receive job offers from different locations and incur a

cost when living apart, a joint search may result in a worse outcome than a single-agent search. Guler et al. (2012) analyzed the search under continuous time but assumed that the partners are ex ante identical, whereas we analyze a one-time decision regarding whether to migrate but present a model that allows the partners to differ ex ante. Gemici (2011) presented a dynamic model with intra-household bargaining and repeated migration decisions, tested it using PSID data, and showed that family ties reduce migration and earnings for both men and women.

A general finding throughout much of the previous literature analyzing internal migration is that couples' migration decisions are greatly influenced by the male's job opportunities.[2] Most previous studies of international migration have focused on men (Chiswick 1978; Borjas 1987; Chiquiar and Hanson 2005; Grogger and Hanson 2011; Abramitzky et al. 2012; 2014). Borjas and Bronars (1991) concluded that the self-selection of migrants who move to the United States with their partners is not as strong with respect to individual characteristics as the self-selection of single migrants. Cobb-Clark (1993) studied female immigrants to the United States and found that women from rich countries with low returns to education and small income differences have relatively higher earnings in the United States. This result suggests that there is a corresponding selection, as among men. Cobb-Clark also found that women who migrated as household members earn significantly higher income than women who did not. A key difference in our analysis is that Borjas and Bronars (1991) and Cobb-Clark (1993) analyzed immigrants from different countries of origin who migrated to one destination. Their results comparing self-selection between single immigrants and immigrant couples establish the joint effect of the differences in self-selection into emigration between single persons and couples and the differences in productivity distribution between single persons and couples, which may persist even after controlling for age and education. Our study includes information regarding all migrants and non-migrants going to all destinations from one country of origin, which allows us to study self-selection into migration among couples and single persons separately from any differences between being single and being part of a couple (see Becker 1985; Dolton and Makepeace 1987).

The remainder of this article is organized as follows: Section II presents the model developed for the migration of single persons and dual-earner couples, with a focus on the couples. Section III describes the data and summary statistics. Section IV provides stylized

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[2] See Duncan and Perrucci (1976), Sandell (1977), Bielby and Bielby (1992), Compton and Pollak (2007), Blackburn (2010), Tenn (2010), and Gemici (2011) for the United States, Rabe (2011) for the United Kingdom, Shihadeh (1991) for Canada, Nivalainen (2004) for Finland, and Eliasson et al. (2014) for Sweden.

facts regarding the emigration and return migration of couples. Section V presents the econometric analyses first for single persons and then for couples. Section VI extends the analyses to migration to different destinations to account for the potential influence of different returns to skill in different destinations and to determine whether the results hold in the absence of immigration restrictions. Section VII concludes.

II. Theory

A. *Migration of a single person*

Individual i earns net income w_i in his or her home country. Net income abroad w_i^A depends on net income at home and an individual-specific random variable x_i, $x_i \in [\underline{x}, \overline{x}]$, such that $\underline{x} < 0 < \overline{x}$:

$$w_i^A = (1 + x_i)w_i.$$

The individual-specific random variable is observable to the individual prior to the migration decision but not to the econometrician in our empirical application. Individual i faces migration cost c_i, which also captures any psychological costs and benefits that are related to living abroad.[3] This cost might include any differences in income between the home and foreign countries that do not depend on home-country income. Therefore, the net return to migrating is given by

$$R_i = x_i w_i - c_i.$$

An individual migrates if the net return to migrating is larger than zero. Assuming that the individual-specific random variable follows a uniform distribution and that $\overline{x} = \underline{x} + 1$, the probability of emigration is given by[4]

$$(1) \qquad p_i = \begin{cases} 0, & if \quad c_i \geq \overline{x} w_i \\ \overline{x} - \frac{c_i}{w_i}, & if \quad c_i < \overline{x} w_i. \end{cases}$$

If $c_i \leq \overline{x} w_i$, $\frac{\partial p_i}{\partial c_i} < 0$ and $\frac{\partial p_i}{\partial w_i} > 0$. In other words, the probability of emigration increases with net income in the home country and decreases with migration costs. Individual migration cost may depend on the level of education, as well as the presence of children. For example, it is plausible that the presence of children increases migration costs. Therefore, we

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[3] For simplicity, we assume that $c_i \geq 0$. This model could be analyzed without this restriction.

[4] An individual emigrates if $x_i > \frac{c_i}{w_i}$. The probability of emigration equals one minus the cumulative distribution function of x_i at this point.

also assume that $-1 < \underline{x} < -0.5$, which guarantees that even without migration costs, less than half of the population would emigrate.

Our model can be interpreted to refer either to a decision regarding permanent migration, in which case income w_i would correspond to the net present value of future income flows, or to a decision about whether to migrate for a certain duration of time, in which case income w_i would correspond to the net present value of income during the eventual period of temporary migration, and c_i would be the net present value of emigration and return migration costs and of any flow costs or benefits of living abroad. This model might be extended to allow for the uncertainty related to returns from abroad by interpreting x_i to refer to the expected value of the individual-specific random variable abroad. Similarly, the migration cost could be stochastic, with c_i reinterpreted as expected migration cost. Our assumption that the difference between earnings abroad and at home is the product of earnings in the home country and a random variable is stronger than necessary to derive the results – but it simplifies the analysis considerably. All that is needed to generate a higher probability of emigration for high-income earners is that the magnitude of potential gains is positively correlated with home-country income.

B. Migration of a couple

A couple consists of two individuals, *a* and *b*. Without loss of generality, assume that $w_a \geq w_b$. The individual-specific random variables x_a and x_b are distributed independently and identically.[5] The couple emigrates if $R_a + R_b > 0$. This condition might arise either due to a unitary model in which the couple maximizes its joint income (Becker 1974; Mincer 1978; Borjas and Bronars 1991) or because of a bargaining model in which the partner who gains from emigration can compensate the partner who loses by making a transfer ex ante. The latter interpretation is adopted by Gemici (2011). The condition for emigration can be written as

$$(2) \qquad x_a w_a + x_b w_b - c_a - c_b > 0.$$

We denote the probability that the couple emigrates by p_{ab}, with the addition of a superscript below to analyze any scenarios that differ in terms of wage differences. The couple does not migrate when $x_a = \underline{x},$ because the gains to the partner with the smaller income cannot exceed the losses to the partner with the larger income due to the assumption $-1 <$

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[5] We make this assumption as we have only data reflecting pre-migration earnings. Assuming a positive correlation between the partners' random variables alleviates trade-offs in couple migration. If the correlation equals 1, a couple corresponds to a single person with migration cost $c_a + c_b$ and wage rate $w_a + w_b$.

$\underline{x} < -0.5$. The lowest possible realization of x_a with which the couple may be indifferent regarding whether to migrate is denoted by $\hat{x}_a$ and is given by

$$\hat{x}_a w_a + \bar{x} w_b - c_a - c_b = 0.$$

This equation allows solving

$$\hat{x}_a = \frac{c_a + c_b}{w_a} - \frac{\bar{x} w_b}{w_a}.$$

Provided that $x_a \geq \hat{x}_a$, the realization of x_b above where the couple migrates is denoted by $\hat{x}_b$ and given by

(3) $$\hat{x}_b(c_a, c_b, w_a, w_b, x_a) = max\left(\frac{c_a+c_b}{w_b} - \frac{x_a w_a}{w_b}, \underline{x}\right).$$

We say that wage differences between the partners are **relatively small** when $\hat{x}_b(c_a, c_b, w_a, w_b, \bar{x}) > \underline{x}$, which implies that the couple would not emigrate when the lower-income earner faces the worst possible realization abroad, even when the higher income earner would obtain the best possible realization. By $\underline{x} = \bar{x} - 1$, this implies that

(4) $$w_b > \frac{\bar{x}}{1-\bar{x}} w_a - \frac{c_a+c_b}{1-\bar{x}}.$$

The probability that the couple migrates with a given x_a is now $\bar{x} - \hat{x}_b(c_a, c_b, w_a, w_b, x_a)$. Integrating over all the possible realizations of the individual-specific random variables provides the probability that the couple emigrates when there are relatively small wage differences:

(5) $$p_{ab}^{small} = \int_{\hat{x}_a}^{\bar{x}} \left(\bar{x} - \frac{c_a+c_b}{w_b} + x_a \frac{w_a}{w_b}\right) dx_a.$$

Inserting $\hat{x}_a$ and simplifying results in

$$p_{ab}^{small} = \bar{x}^2\left(1 + \frac{w_a}{2w_b} + \frac{w_b}{2w_a}\right) - \frac{c_a+c_b}{w_b}\bar{x} - \frac{c_a+c_b}{w_a}\bar{x} + \frac{(c_a+c_b)^2}{2w_a w_b}.$$

When income differences between the partners are **relatively large,** such that $\hat{x}_b(c_a, c_b, w_a, w_b, \bar{x}) = \underline{x}$, we can calculate for each x_b the minimum value of x_a with which the couple is indifferent regarding whether to migrate:

$$x_a(c_a, c_b, w_a, w_b, x_b) w_a + x_b w_b - c_a - c_b = 0.$$

This equation allows solving

$$x_a(c_a, c_b, w_a, w_b, x_b) = \frac{c_a+c_b}{w_a} - x_b \frac{w_b}{w_a}.$$

The probability that the couple emigrates is in this case:

(6) $$p_{ab}^{large} = \int_{\underline{x}}^{\bar{x}} \left(\bar{x} - \frac{c_a+c_b}{w_a} + x_b \frac{w_b}{w_a}\right) dx_b = \bar{x} - \frac{c_a+c_b}{w_a} + \frac{w_b}{2w_a}(2\bar{x} - 1).$$

Figure 1 illustrates how the migration probabilities are derived when $c_a = c_b = c$. The left panel presents $w_a = w_b$ (i.e., small wage differences), and the right panel presents $w_a =$

$2w_b$ (i.e., large wage differences). In both panels, the parameter combinations under which a couple emigrates are shaded two different tones of grey. The probability that a couple emigrates is calculated by integrating over all the possible combinations of x_a and x_b with which the couple emigrates, using formula (5) for small wage differences (left panel) and formula (6) for large wage differences (right panel). The dark grey area denotes the parameter combinations under which both partners would emigrate also as single persons. The light grey areas denote the parameter combinations under which only one partner would emigrate as a single person, but his or her gains are sufficiently large to compensate for the losses to the other partner who is then a tied mover. Figure 1 also illustrates that either partner may be a tied stayer in our model. The probability of the secondary earner being a tied stayer can be found by drawing a horizontal line crossing the vertical axis at point $\frac{c}{w_b}$ and is given by the white area above this line. The probability of the primary earner being a tied stayer can be found by drawing a vertical line crossing the horizontal axis at point $\frac{c}{w_a}$ and is given by the white area to the right of this line.

Small wage differences   Large wage differences
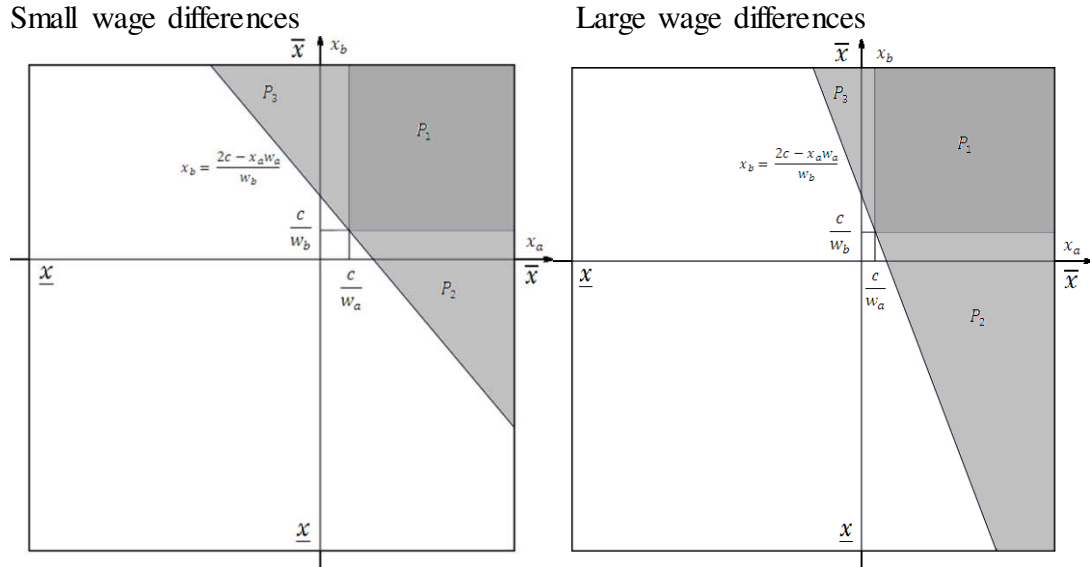
FIG. 1. -Migration probabilities for single persons and couples. The left panel depicts the case of small wage differences and the right panel depicts the case of large wage differences. In both panels, the horizontal axis measures all the possible realizations of x_a and the vertical axis measures all the possible realizations of x_b. If single, agent a (b) would emigrate with all the realizations of x_a (x_b) to the right of point $\frac{c}{w_a}$ (above point $\frac{c}{w_b}$). If a and b are a couple and $c_a = c_b = c$, the inequality (2) indicates that the couple would only emigrate when $x_b > \frac{2c - x_a w_a}{w_b}$. Given the assumption that x_a and x_b are distributed uniformly and independently on unit intervals, the grey area shows the probability that the couple would emigrate. In the left panel, $w_a = w_b$, and the

probability that the couple would emigrate even if only a emigrates as a single person (the area of the triangle marked by P_2) is identical to the probability that the couple would emigrate even if only b emigrates as a single person (the area of the triangle marked by P_3). The probability that both partners would prefer to emigrate (the area of the square marked by P_1) is the product of the probabilities that a and b would migrate as single persons. In the right panel, the other parameter values are as in A but $w_a = 2w_b$ (i.e., large wage differences). The rectangle marked by P_1 is larger than in the left panel because the probability that b would emigrate as a single person does not change, whereas the probability that a would emigrate as a single person increases. The area marked by P_2 (partner b is the tied mover) now has a trapezoid shape because, with large wage differences, a couple should emigrate with sufficiently high realizations of x_a also when b faces the worst possible realization of $\underline{x}$. The bottom line of the trapezoid is where $\hat{x}_b = \underline{x}$ by (3). The triangle marked by P_3 (partner a is the tied mover) is clearly smaller than in the left panel. The higher the earnings of the (pre-migration) primary earner, the less likely it is that he or she will become a tied mover.

If migration costs between the partners differ sufficiently, it is trivial to show that the partner with the lower migration cost is more likely to emigrate as a single person. Importantly, we can show that being in a couple reduces the probability of emigration for the higher income earner when the migration costs are the same for both partners:

PROPOSITION 1. If migration costs are the same for both partners, a couple is always less likely to emigrate than the partner with higher earnings would be as a single person.

It is also possible to show the following:

PROPOSITION 2. An increase in the home-country wage of the higher wage partner increases the probability that a couple emigrates.

PROPOSITION 3. An increase in the home-country wage of the lower wage partner has an ambiguous effect on the probability that the couple emigrates. If the effect is positive, it is always smaller than the effect of a corresponding increase in the primary earner's home-country wage.

PROPOSITION 4. An increase in migration costs for either partner reduces the probability that a couple emigrates.

PROPOSITION 5. If migration costs are the same for both partners, the elasticity of migration of a couple with respect to the primary (secondary) earner's home-country wage is always

larger (smaller) than the elasticity of migration of the primary (secondary) earner with respect to his or her home-country wage would be as a single person.

Proofs for these propositions are presented in Appendix A.

The probability of emigration always increases with the primary earner's income because the potential gains for the couple increase with the primary earner's income. Additionally, when one partner is a tied mover, it is typically the secondary earner; see Figure 1. An increase in the secondary earner's income has two conflicting effects. There is a positive effect when the potential gains from a good job opportunity abroad are proportional to pre-migration productivity. There is a negative effect when an increase in the secondary earner's income generates possible losses as a result of being the tied mover, thereby making it more likely that partner a would have to give up a good job offer abroad because the gains are not sufficient to compensate for partner b's losses. It is not clear which effect dominates, as illustrated in the proof of Proposition 3.

Our simple theoretical model generates a number of empirically testable predictions. Propositions 2 and 3 list predictions regarding the effects of the earnings of the primary and secondary earners. There are additional predictions if migration costs decrease with the level of education.[6] Proposition 4 would then imply that – controlling for wages – power couples should be most likely to emigrate and low-power couples should be least likely to emigrate, with female- and male-power couples' likelihood falling in between. Given that college-educated individuals earn more than those without a college education, we would expect differences in emigration rates when not controlling for home-country wages. According to (2), a reduction in migration costs has the corresponding effect of a proportionate increase in the wage rates. Thus, Proposition 4 implies that a proportional increase in the home-country wage rates of both partners increases the likelihood that a couple will emigrate. Proposition 5 allows us to test our model against the model developed by Borjas and Bronars (1991), which predicts that migrants in couples are more weakly self-selected than

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[6] Examining data from Docquier and Marfouk (2006), Grogger and Hanson (2011) showed that emigrants are generally better educated than non-migrants. Docquier, Lowell and Marfouk (2009) showed that high-skilled emigration rates to OECD destinations exceed emigration rates to OECD destinations for those with less education across all continents – and even across all regional groups using the United Nations classifications (these groups include North America, Eastern Europe, Northern Europe, Southern Europe and Western Europe). The lower migration costs of college-educated individuals may be due to better language and cross-cultural skills. The mobility of highly skilled individuals may depend on the type of their education (Poutvaara 2008). To keep the current analysis tractable, we abstract from the modeling of differences in the degree to which different types of education are internationally applicable.

single persons. For a country with a relatively egalitarian income distribution, such as Denmark, this prediction implies that the elasticity of migration with respect to earnings should be higher for single persons. Our model predicts that primary earners in couples are more strongly self-selected than single persons, whereas secondary earners in couples are more weakly self-selected. Therefore, the elasticity of migration regarding the primary (secondary) earners' income should be larger (smaller) than with respect to single persons' income.

It is illustrative to compare the assumptions and predictions arising from our model with those from the model developed in Borjas and Bronars (1991). We assume stochastic job opportunities abroad but no differences in skill prices, whereas Borjas and Bronars (1991) assume that earnings abroad are perfectly correlated with earnings at home, but that skill prices may differ. If two partners have the same income in a home country ($w_a = w_b$), then the two partners gain or lose equally from migration; thus, the Borjas and Bronars model predicts that there will be no tied movers or stayers. In our model, either partner has an equal probability of being the tied mover or stayer when $w_a = w_b$ (if there could be no tied movers with equal home-country wages, the triangles marked by P_2 and P_3 should vanish in the left panel of Figure 1). If the partners' incomes differ, Borjas and Bronars (1991) predict that the identity of the tied movers or stayers depends deterministically on the relative earnings of the partners. If skill prices are higher at the destination, the tied movers are always the secondary earners and the tied stayers are always the primary earners. In our model, either partner can be a tied mover or stayer; however, the probability of being a tied mover is greater for the secondary earner (the trapezoid marked P_2 is larger than the triangle marked P_3 in the right panel; in the left panel, an increasing w_a relative to w_b would tilt the line such that the triangle marked P_2 would be larger than the triangle marked P_3).

It should be noted that our model might be applied with risk neutrality when only one partner receives a job offer from abroad prior to the migration decision and there is uncertainty regarding the job opportunities for the other partner. Here, the individual-specific term x_{offer} for the partner who received the job offer abroad is known, whereas the term $x_{no\ offer}$ for the other partner reflects his or her expected job opportunities abroad. This model considers that the job offers may be made to either partner. Nonetheless, the model is restricted because the duration of the eventual stay abroad must be known in advance, regardless of whether it is permanent or temporary. To model the optimal choice regarding the duration of the stay abroad, we must specify the wage process abroad, as well as distinguish between fixed emigration and return migration costs, in addition to flow costs related

to staying abroad. We refrain from suggesting a more complex modeling of the wage process abroad because the data used to test our theory are restricted to the country of origin.

III. Data and Summary Statistics

Like other Scandinavian countries, Denmark collects unusually comprehensive register data. Our main register data sources are the population register, income tax register, education register, register on wages and occupations, and the migration register. Data from various registers are combined using a unique personal identification number (i.e., social security number). By law, all residents in Denmark have a social security number, which is necessary for everyday life events, including opening a bank account, receiving wages or social assistance, visiting a doctor or being registered at school. Registering migration is compulsory if the stay abroad is longer than six months. The migration register provides information regarding the dates of migration and the countries of destination, as well as return migration. The present paper uses register data from the entire Danish population from 1982 to 2010. We accessed these data through Statistics Denmark. The age of the partners and the presence and ages of children are measured on January 1. Education is measured as of October 1 and occupation during the last week of November. When explaining emigration decisions, we use values for education, occupation and earnings from the previous year – and for age and the presence of children on January 1 of the year of analysis.

In this paper, a couple consists of a male and female who have lived at the same address for at least one year.[7] A couple is defined based on having a shared address rather than being married given that cohabiting without marriage is common in Denmark. If both partners migrate to the same country within one year, we interpret that event as the couple migrating together. We restrict our focus to couples in which at least one parent of both partners was born in Denmark.[8]

Figure 2 presents the average annual emigration rates from 2001 to 2005 for single men and women, and for couples in which both partners migrate to the same county. Couples

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[7] The Statistics Denmark definition requires that if the male and female do not have children together, their age difference should be less than 15 years. We restrict our attention to opposite-gender couples because the number of same-gender couples was clearly smaller and because there are many cases – particularly among students – in which two persons of the same gender share an apartment without forming a couple.

[8] For immigrants, emigrating from Denmark might mean returning to the home country. Therefore, their decisions may differ significantly from non-immigrants. The current analysis exclude couples that migrated to the Faroe Islands and Greenland, as these are autonomous Danish territories.

are listed according to the female's age, which is measured as of January 1. The single person analysis is restricted to those who had at least one parent who was born in Denmark. Panel A includes all emigration events, whereas panel B is restricted to emigration events that last at least five years, which is defined for couples as neither partner returning to Denmark within five years. We present results both without restricting the duration of the stay abroad and with this restriction given that there are good arguments for both approaches. On one hand, couples do not need to know how long they are going to stay abroad and plans may change, which is an argument in favor of not restricting the duration of stay abroad. On the other hand, many short stays abroad occur when one partner is sent abroad by his or her employer, typically for one year or for a few years. Because most couples return within five years, the results for that group may be driven to a large extent by the couples in which at least one partner is a posted worker. We present the results for all stays and for only the longer stays to show the extent to which the results hold for both groups.

A: All stays   B: Stays lasting at least five years

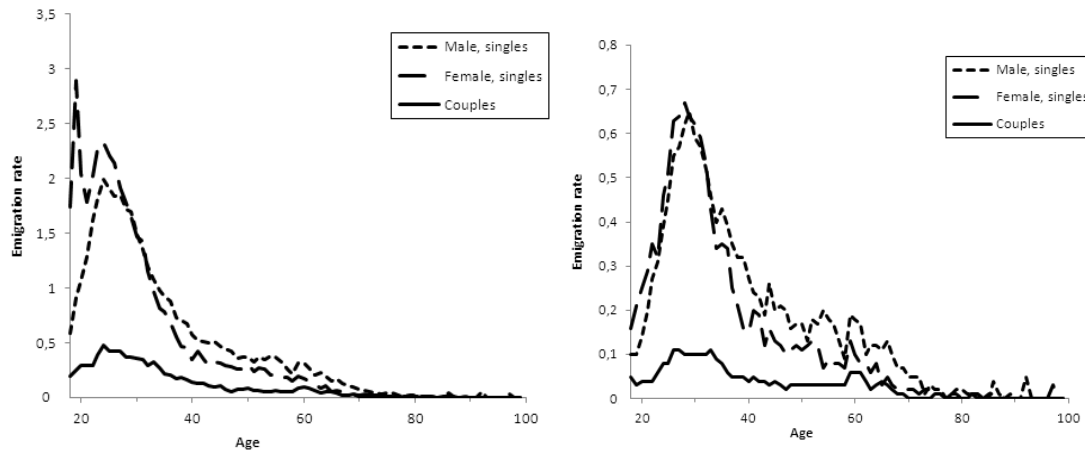FIG. 2. - Family status and emigration probabilities. The horizontal axis denotes age and the vertical axis denotes the percentage of single persons (or couples measured according to female age) who emigrated at that age.

Figure 2 shows that single persons are considerably more mobile than couples regardless of whether one analyzes all the emigration periods or only the long periods. Mincer (1978)

established that family ties deter within-country migration, and Figure 2 shows that the same result holds for international migration.[9]

The remainder of this paper focuses on couples in which both the female and male are between 25 and 37 years of age and – for purposes of comparison – single women and men in the same age group. A previous version of this paper, which is available as IZA DP 8352, featured age restrictions in which the male was between 25 and 39 years of age, and the female was between 23 to 37 years of age, following Costa and Kahn (2000). The results with these restrictions were similar to those in this paper; however, the gender differences were somewhat larger in the previous version than in the current version, which employs the same age restrictions for women and men. Couples with missing information regarding either education or occupation are excluded, which reduces the number of observations by approximately one percent. Table 1 reports the number of households that satisfied the aforementioned restrictions and the percentage of couples that emigrated together from 1982 to 2010. The emigration rate has increased since the mid-1990s, which may be the result of the introduction of free mobility in the European Union in 1993.

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[9] The difference between single persons and couples should not be interpreted as just a causal effect of family ties because people in couples may differ systematically from single persons. However, the differences between single persons and couples are so great that it is not plausible that they would only reflect self-selection into couples, particularly as these differences hold independent of age. Because our focus is on understanding couple migration decisions and not on explaining those who are in couples, we do not account for the endogeneity of couple formation in our analysis.

TABLE 1: EMIGRATION RATES OF COUPLES (IN PERCENTAGES), 1982-2010

	Emigration Rate	Couples
1982	0.16	266,517
1983	0.12	256,726
1984	0.12	246,510
1985	0.13	236,674
1986	0.13	228,747
1987	0.15	223,851
1988	0.20	221,245
1989	0.25	218,592
1990	0.21	217,093
1991	0.18	217,335
1992	0.18	218,862
1993	0.19	220,244
1994	0.21	219,675
1995	0.22	218,447
1996	0.24	218,078
1997	0.25	218,275
1998	0.25	218,731
1999	0.25	217,514
2000	0.30	216,217
2001	0.29	213,441
2002	0.23	208,650
2003	0.22	202,257
2004	0.25	195,533
2005	0.28	187,404
2006	0.29	183,343
2007	0.31	179,817
2008	0.26	176,235
2009	0.20	171,859
2010	0.21	165,511
Total	0.22	6,183,383

Note: Calculations are based on couples satisfying the restrictions listed in the text.

In total, 61% of couples are low-power couples, 15% are power couples, 14% are female-power couples and 10% are male-power couples. In 78% of the couples, both the male and female work. In 9% (7%) of the couples, the male works and the female is out of the labor force (unemployed). The female works and the male is out of the labor force (unemployed) in only 2% (2%) of the couples. Students are included as among those who are not part of the labor force.

IV. Stylized Facts

In this section, we provide an overview of emigration and return migration before proceeding to the econometric analysis in section V. Panel A in Table 2 presents the likelihood that emigration will occur in couples with different levels of education. Low education denotes less than a college degree, and high education denotes a college degree or more. As a comparison, the emigration rate for single women (men) without a college education is 0.82% (0.74%), whereas the emigration rate for single women (men) with a college education is 1.65% (1.89%). Thus, couples are considerably less likely to migrate than either single men or women, independent of education. Power couples are six times more likely to emigrate than low-power couples. Male-power couples are somewhat less likely to emigrate than power couples, whereas the emigration rate of female-power couples is closer to that of the low-power couples than to that of the male-power couples or power couples. These findings suggest that emigration decisions are primarily influenced by the job opportunities for the male. One possible explanation for this finding is that Denmark's high female labor force participation rate is due in part to its extensive daycare system; however, most destination countries have much more limited or expensive daycare services. This explanation means that even college-educated women are more likely to stay at home to take care of their children, thereby making the emigration decision more dependent on the male's labor market prospects. Table A.1 in the Appendix shows that the emigration rates are almost identical when the focus is restricted to married couples. Therefore, the remainder of the paper presents results only when cohabiting couples are also included.

Panels B and C in Table 2 present the emigration rates separately for couples in which the females earn more and in which the males earn more. In both groups, the emigration rate is highest for power couples, followed by male-power couples. The emigration rates for the female-power couples are between the low-power and male-power couples. The emigration rates for the low-power and female-power couples are approximately the same, regardless of whether the male or female earns more. The emigration rates for the power couples and male-power couples are considerably higher when the male earns more. Together, these stylized findings suggest a rather traditional family migration pattern that is weakened, but not reversed, in couples in which the female is the primary earner. Restricting the analysis to dual-earner couples in which both partners worked at least 60% of the full working time in the previous year does not change the qualitative picture. Regardless of whether the male or female earns more, power couples are most likely to emigrate, followed by male-power couples and then by female-power couples.

TABLE 2. EMIGRATION RATES OF COUPLES DEPENDING ON EDUCATION, EMPLOYMENT, AND CHILDREN

		Panel A: Emigration rates (in percentages) according to partners' education	
		Male education	
		Low	High
Female	Low	0.10	0.45
education	High	0.21	0.60

		Panel B: Emigration rates when females earned more	
		Male	
		Low	High
Female	Low	0.09	0.34
education	High	0.19	0.50

		Panel C: Emigration rates when males earned more	
		Male	
		Low	High
Female	Low	0.10	0.49
education	High	0.22	0.65

		Panel D: Emigration rates according to partners' employment status (in percentages)	
		Male	
		Working	Not working
Female	Working	0.22	0.34
	Not working	0.26	0.37

Panel E: Number of children and emigration rates	
Number of children	Emigration rates (in percentages)
0	0.36
1	0.22
2	0.18
3+	0.17

Note: Employment status in panel D is measured in the year before emigration.

Panel D in Table 2 shows the emigration probabilities based on whether the spouses are employed. The emigration rates are highest for couples in which neither partner is working and lowest for couples in which both partners are working. It is intuitive that couples in which both partners are working are less likely to emigrate because the tied mover has more to lose in this type of couple. Emigration is more likely to occur when the male is not working and the female is working than when the male is working and the female not working, again suggesting that couples are more willing to sacrifice the female's current employment to take advantage of a good job opportunity abroad for the currently unemployed male partner than the reverse. We also find that couples are most likely to emigrate when they have no children (see panel E in Table 2), which is also intuitive because the presence of children adds additional family ties that may deter migration.

Most couples return to Denmark within a few years. Figure 3 presents the survival rates of couples that emigrated. Survival as emigrants is defined as neither partner returning to Denmark. There are no data indicating whether the partners remained a couple abroad when neither returned. High-power and part-power (male-power and female-power) couples are considerably more likely to return than low-power couples. With respect to emigration between 1982 and 2005, 81% of the power couples, 77-78% of the female-power and male-power couples and 70% of the low-power couples return within five years of leaving Denmark.
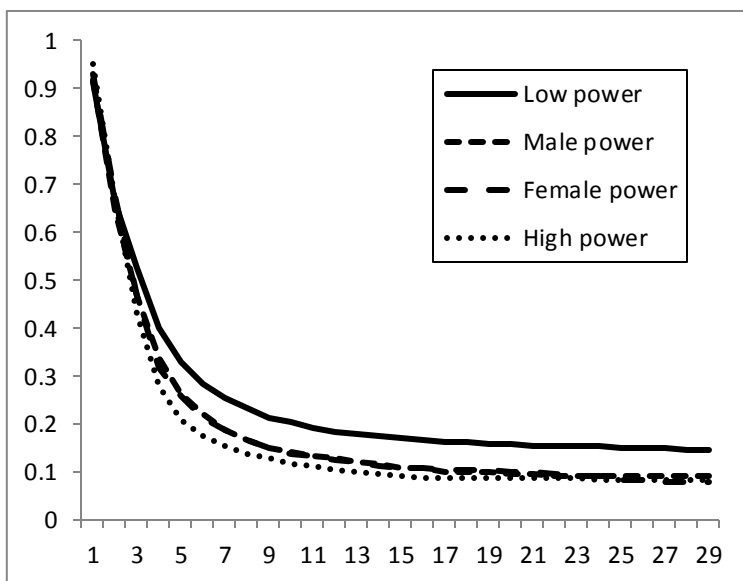
FIG. 3. - Survival rates for staying abroad in emigrating couples. The horizontal axis denotes the number of years spent abroad and the vertical axis denotes the fraction of couples still staying abroad.

V. Econometric Analysis

The previous section established that the emigration rate is highest for power couples, followed by male-power couples. The lowest emigration rate is for the low-power couples. To test the effects of the primary and secondary earners' incomes when other characteristics are taken into account, we utilize a regression analysis. Because the decision to emigrate is a zero-one decision, we use a probit model for emigration. First, we analyze the emigration decisions of single men and women and then we analyze these same decisions for the dual-earner couples because these couples comprise the subgroup of couples to which our theoretical model applies best. In the final subsection, we present an analysis of all the couples that satisfy our age restrictions. All the regressions in this section include age and year

dummy variables with a separate dummy variable for each age in full years (not reported, but available upon request) to capture the lifecycle patterns that are evident in Figure 2, as well as the time trends and the effect of business cycles on migration.

A. *Single persons*

Table 3 presents the probit regression for emigration decisions of single women and men without children. This analysis is restricted to those between 25 and 37 years of age who worked at least 60% of the full working time during the previous year, which corresponds to approximately seven months.

TABLE 3: PROBIT REGRESSION FOR THE EMIGRATION OF SINGLE PERSONS

	Female	Male	Female, no return within five years	Male, no return within five years
Intercept	-4.33***	-5.98***	-5.70***	-7.08***
	(0.18)	(0.14)	(0.32)	(0.27)
College-educated	0.25***	0.35***	0.16***	0.29***
	(0.01)	(0.01)	(0.01)	(0.01)
Log earnings	0.12**	0.25***	0.22***	0.33***
	(0.01)	(0.01)	(0.03)	(0.02)
Observations	1,096,857	2,535,762	934,235	2,191,160

Notes: Dummy variables for age and year are included in all the models. The first two columns present data from 1982 to 2010, and the last two columns present data from 1982 to 2005. A total of 0.2% of men and 0.1% of women are excluded from the analysis due to zero or negative reported earnings. Robust standard errors clustered at the individual level are presented within parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

The results in Table 3 are consistent with our theoretical model that predicts that the probability that a single person emigrates increases with earnings for both men and women. These results are also consistent with our prediction that migration costs are lower for college-educated individuals, which makes them more mobile than less-educated individuals, even when controlling for age and earnings.

To illustrate how responsive emigration behavior of single persons is to their earnings, we calculate the elasticity of migration with respect to earnings for single women and men with and without a college education separately for all the stays and then for only the long

stays. The formula for elasticity in each group, omitting group-specific subscripts, is $\frac{dp}{dw}\frac{w}{p}$.
Here, w denotes earnings, which is one component of vector $\mathbf{x}$ for the explanatory variables. $p=\Phi(\overline{x}\beta)$ is the probability of emigration as a function of the log earnings and other explanatory variables, as estimated using the probit regression summarized in Table 3, evaluated at the average values for the analyzed group.[10]

Panel A in Figure 4 shows that the probability of emigration for college-educated single persons and for single men without a college education strongly increases with their incomes, which is consistent with the theoretical model for single persons. The only exception to this result is evident in the results for single women without a college education: For them, the probability of emigration only slightly increases with earnings. Panel B illustrates long-term emigration by focusing on only the events in which the emigrant did not return to Denmark within five years. Long-term emigration is more influenced by pre-emigration earnings compared with all other emigration events, which implies that there is a condition regarding emigration in which the probability of returning within five years decreases with pre-migration earnings. Overall, the elasticity of the migration with respect to earnings varies for men across the different groups between 0.59 and 1.10, and for women between 0.14 and 0.90.

A: All stays   B: Stays lasting at least five years
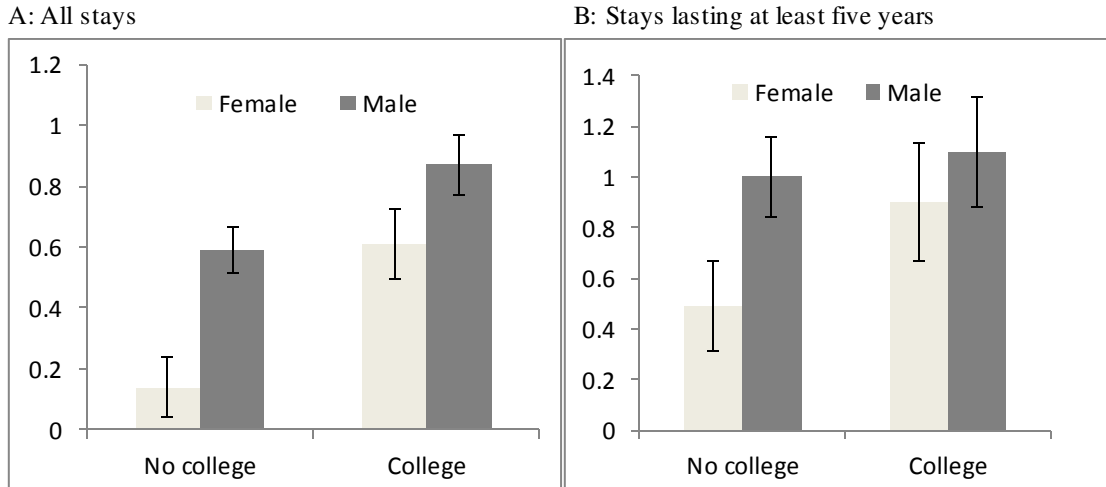
FIG. 4. – The elasticity of migration for single persons with respect to income. The results are presented as elasticity with 95% confidence intervals, which are estimated at the average age and income within the group for which the elasticity is calculated. Women and men are between 25 and 37 years of age. The emigration

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[10] Note that $dln(w) = \frac{dw}{w}$. Therefore, $\frac{dp}{dw}\frac{w}{p}=\frac{dp}{dln(w)}\frac{1}{p}$. We use this formula next because the probit regression in Table 3 uses the log income.

years are 1982 to 2010 in panel A and 1982 to 2005 in panel B. The probability of emigration estimated based on earnings in the previous year for those individuals who worked at least 60% of the full working time.

One possible explanation for the gender differences between earnings and the probability of emigration is that women are more likely to work in the public sector, which has smaller income differences than the private sector in which most men work. We do not include any controls for the sector of employment or the field of study that individuals are engaged in because our main interest lies in how single persons' income levels are related to their probabilities of emigration and how this relationship differs between single men and women, not in explaining differences in income levels. Our estimated elasticities should not be interpreted as causal claims regarding how much providing an individual with additional income would increase his or her probability of emigration. Rather, we aim at identifying patterns related to migration at the population level. When analyzing couples, our main question is whether the earnings of the primary and secondary earners are related to the probability that couples will emigrate; we do not aim to explain primary and secondary earners' incomes.

We can compare the elasticities that we estimate with those from Kleven et al. (2014), who used Danish register data to estimate the impact of introducing a special flat-rate tax scheme for top-income earning immigrants on the immigration of top-income earners to Denmark. The eligibility threshold was approximately 100,000 Euros, which corresponds to approximately the 99th percentile of individual earnings in Denmark. These authors estimated the elasticity of migration as one minus the average tax rate for foreigners, finding a very large elasticity that is between 1.5 and 2. According to Kleven et al., a one-percent increase in the fraction of a person's income that remained after taxes increased the number of high-income immigrants to Denmark by 1.5–2%. According to our estimates, a 1% increase in the income of a single man between 25 and 37 years of age increases the likelihood that he will emigrate for five or more years by approximately 1% relative to the baseline probability of emigration. The elasticities that we estimate are clearly smaller than the elasticities that Kleven et al. found. However, because Kleven et al. analyzed immigrants who were in the top 1% of the income distribution in Denmark, it is not surprising that the elasticity of immigration with respect to the share of income that they were able to keep after taxes was higher than the elasticity of emigration with respect to the income that we estimate for all single persons working at least 60% of the full working time during the previous year.

Although the elasticities that we find for single persons are smaller than those found by Kleven et al., our elasticities are nonetheless rather large. In addition, they are likely to be a joint effect of two mechanisms. One mechanism is highlighted in our model, namely that high-income earners are more likely to emigrate even in the absence of differences in returns to skill when the potential gains depend on earnings in the home country. Another mechanism arises from cross-country differences in returns to skill, which is omitted from our theoretical model. Because Denmark has a relatively flat income distribution, the Roy-Borjas model predicts that emigrants from Denmark should be positively selected (see Borjas 1987). However, skill price differences affect both men and women; therefore, these differences should not change the qualitative conclusions related to gender differences. We return to the implications of the Roy-Borjas model for our findings in section VI.

B. Dual-earner couples

For the analysis of couples, the dependent variable obtains a value of one when the couple migrated together and a value of zero otherwise. Our main results are presented in Table 4. We focus our analysis on couples in which both partners worked at least 60% of the full working time during the previous year, which corresponds to approximately seven months. We also required that both partners have positive earnings. It is not plausible that someone who worked more than half of the year would have zero or negative earnings, although it is technically possible in the register data in the rare cases that involve the self-employed because of various tax deductions (0.07% of couples are excluded because either the male or female had earnings that are not larger than zero). This restriction brings the empirical analysis closest to the theoretical model. We present the results first for all the emigration periods and then for only the long emigration periods, which is defined as when neither partner returned to Denmark within five years. To allow for testing of the effect of the primary earner's income and any potential gender differences, the first and third columns analyze the couples in which the females earned more and the second and fourth columns analyze the couples in which the males earned more. Across all these cases, power couples are most likely to emigrate, followed by male-power couples. The low-power couples are always least likely to emigrate, which is consistent with Proposition 4 that posits that emigration costs would be lower for college-educated individuals.

TABLE 4: PROBIT REGRESSION FOR THE EMIGRATION OF DUAL-EARNER COUPLES

		Female earned more	Male earned more	Female earned more, 5+ years abroad	Male earned more, 5+ years abroad
Intercept		-10.51***	-12.97***	-10.08***	-14.03***
		(0.68)	(0.25)	(1.31)	(0.48)
Power couples		0.49***	0.47***	0.23***	0.22***
		(0.03)	(0.01)	(0.06)	(0.02)
Female-power couples		0.18***	0.17***	0.05	0.07**
		(0.03)	(0.02)	(0.07)	(0.03)
Male-power couples		0.36***	0.39***	0.24***	0.23***
		(0.04)	(0.01)	(0.08)	(0.02)
[Low-power couples]					
Number of children	1	-0.27	-0.27***	-0.16	-0.48*
		(0.29)	(0.10)	(0.19)	(0.27)
	2	-0.18	-0.18*	0.01	-0.43
		(0.29)	(0.10)	(0.18)	(0.27)
	3+	-0.08	-0.16	0.26	-0.36
		(0.30)	(0.10)	(0.16)	(0.26)
	[0]				
Female log earnings		0.62***	0.04***	0.60***	0.07**
		(0.06)	(0.02)	(0.10)	(0.03)
Male log earnings		-0.06	0.71***	-0.09	0.77***
		(0.05)	(0.01)	(0.09)	(0.02)
Observations		502,324	2,658,710	417,587	2,340,201

Notes: Dummy variables for the age of the female, age of the male, age of the oldest child and year are included in all models. Robust standard errors clustered at the household level are presented in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4 presents results that are consistent with the predictions from our theoretical model: regardless of whether the male or female earns more, the probability that a couple will emigrate increases with the primary earner's income. The previous literature regarding family migration has not studied the effects of male and female earnings separately for couples with respect to whether the male or female is the primary earner (see Duncan and Perrucci 1976; Mincer 1978; Shihadeh 1991; Nivalainen 2004; Blackburn 2010; Tenn 2010; Rabe 2011; Gemici 2011; Eliasson et al. 2014). When couples with male and female primary earners are analyzed together, the estimated effect of the male's income is typically positive, whereas that of the female's income is typically insignificant and may even be negative. The positive effect of the female primary earner's income on the probability of

migration is lost when the relatively small number of families with female primary earners is analyzed together with families with males as the primary earners.

We also find that the probability that a family with a male primary earner will emigrate increases with the female secondary earner's income, whereas the probability that a family with a female primary earner will emigrate does not increase with the male secondary earner's income. The point estimate for the male secondary earner's income is negative but statistically insignificant. Although it is somewhat surprising that the sign of the estimated effect for the secondary earner's income differs according to gender, it is notable that the magnitude of the effects is small.

After controlling for income, we also find that having a college education increases the likelihood of emigration. This result is consistent with our prediction that higher education makes migration easier, although it is also consistent with an alternative interpretation that the returns to migration are higher for the college-educated. Furthermore, male-power couples are more mobile than female-power couples regardless of whether the male or female is the primary earner. This finding suggests that family migration patterns are still not gender neutral. Although family migration decisions are strongly influenced by the primary earner's income, regardless of the primary earner's gender, the male partner's college education plays a stronger role in encouraging emigration, regardless of which partner earns more.

Our finding regarding the importance of the primary earner's income is robust to different specifications. Foged (2014) used the same data that we use but with slightly different empirical specifications and a shorter time period. Instead of investigating the primary and secondary earners' incomes, she examined the husband's income share and found that the probability of family migration is U-shaped with respect to the income share of the husband, which is consistent with the predictions of Propositions 2 and 3 in the present paper. Moving toward a more asymmetric income distribution (i.e., moving toward the endpoints of the U) is equivalent to increasing the income of the primary earner (Proposition 2) and reducing the income of the secondary earner by the same amount (Proposition 3). Taken together, Propositions 2 and 3 suggest an increased probability that a couple will emigrate.

Table 5 presents the data for the analyses of couples with and without children separately (An analysis of couples with one child, two children, or three or more children suggests that accounting for the number of children does not make much difference). Independent of the number of children, power couples are most likely to emigrate, followed by male-power couples and then by female-power couples. This finding is consistent with Proposition 4, which posits that the cost of emigration is lower for individuals with college educations.

We find that the probability of emigration increases strongly with the primary earner's income, as Proposition 2 predicts. The emigration decisions of couples with and without children are influenced by the primary earner's income quite similarly, regardless of the primary earner's gender. The income of a female secondary earner has a small and weakly statistically significant positive effect, whereas the effect of the male secondary earner's income is statistically insignificant. Therefore, Proposition 3's prediction, that migration would increase more with the primary earner's income, is confirmed across all the groups.

TABLE 5: CHILDREN AND THE EMIGRATION OF DUAL-EARNER COUPLES

	No children, female earned more	No children, male earned more	With children, female earned more	With children, male earned more
Intercept	-10.77***	-12.70***	-10.78***	-13.43***
	(1.11)	(0.52)	(0.90)	(0.30)
Power couples	0.39***	0.44***	0.56***	0.47***
	(0.04)	(0.02)	(0.04)	(0.01)
Female-power couples	0.11***	0.17***	0.24***	0.16***
	(0.05)	(0.03)	(0.04)	(0.02)
Male-power couples	0.30***	0.36***	0.40***	0.39***
	(0.06)	(0.02)	(0.06)	(0.01)
[Low-power couples]				
Female log earnings	0.62***	0.09**	0.62***	0.04*
	(0.09)	(0.04)	(0.08)	(0.02)
Male log earnings	-0.08	0.64***	-0.05	0.73***
	(0.07)	(0.03)	(0.07)	(0.02)
Observations	150,646	532,067	351,678	2,126,643

Notes: Dummy variables for the age of the female, age of the male, and year are included in all the models. The age of the oldest child is included in all models with children. Robust standard errors clustered at the household level are presented in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6 presents data from couples according to both power types and the primary earner's gender. This division is motivated by concerns that there may be collinearity between education and earnings and that the effects of earnings may interact with education. An analysis of the eight groups consisting of the four power types with females as the primary earners, and the four power types with males as the primary earners allows us to separate the effects of income without any collinearity with education. It also separates any potential gender differences from the effects of being a primary or secondary earner. Given the large number of observations, there is enough variation in the earnings to allow for an analysis of the subgroups. However, the inclusion of education and income together in Table 4 allows us to estimate the direct effects of education beyond the indirect effects associated with earnings.

Panel A in Table 6 shows that among couples with females as the primary earners, the probability of migration strongly increases with females' earnings for low-power couples, female-power couples and power couples. The probability of migration decreases with male earnings among low-power and female-power couples, although the latter effect is statistically insignificant. Nonetheless, it appears that male secondary earners without college education are negatively self-selected with respect to their incomes. Taken together, these findings suggest that among couples in which the females earned more, the migration decisions reflected more female job market opportunities in all the groups except for the male-power couples. Among couples with males as the primary earners, the probability of migration increases with male earnings, independent of power type (see panel B). The effect of female earnings is positive for the male-power and low-power couples.

One potential concern related to our analysis is whether the number of emigrating couples is too small in some subgroups. Table A.3 shows that the group sizes are not too small for our analysis.

TABLE 6: EMIGRATION ACCORDING TO POWER TYPE AND PRIMARY EARNER'S GENDER

		Panel A: Female earned more			
		Low-power	Female-power	Male-power	Power couples
Intercept		-9.23***	-11.49***	-10.18***	-10.75***
		(1.49)	(1.64)	(2.59)	(0.93)
Number of children	1	-0.22	-0.17	0.30	0.31
		(0.19)	(0.30)	(0.35)	(0.39)
	2	-0.12	-0.00	0.20	0.37
		(0.18)	(0.29)	(0.35)	(0.39)
	3+	-0.00	0.01	0	0.53
		(0.19)	(0.32)		(0.39)
	[0]				
Female log earnings		0.65***	0.80***	0.20	0.56***
		(0.12)	(0.19)	(0.21)	(0.09)
Male log earnings		-0.21***	-0.18	0.37*	0.06
		(0.07)	(0.12)	(0.22)	(0.08)
Observations		257,569	116,519	21,064	90,607

		Panel B: Male earned more			
		Low-power	Female-power	Male-power	Power couples
Intercept		-14.90***	-11.63***	-13.99***	-11.18***
		(0.49)	(0.78)	(0.57)	(0.38)
Number of children	1	-0.44***	-0.09	-0.08	-0.31
		(0.17)	(0.33)	(0.19)	(0.31)
	2	-0.37**	-0.09	0.03	-0.19
		(0.17)	(0.33)	(0.19)	(0.33)
	3 +	-0.39**	0.05	0.04	-0.15
		(0.17)	(0.33)	(0.18)	(0.33)
	[0]				
Female log earnings		0.09***	-0.07	0.10***	0.03
		(0.03)	(0.05)	(0.04)	(0.03)
Male log earnings		0.83***	0.71***	0.75***	0.61***
		(0.03)	(0.04)	(0.03)	(0.02)
Observations		1,596,144	359,593	273,467	429,506

Notes: Dummy variables for the age of the female, age of the male, age of the oldest child and year are included in all the models. Robust standard errors clustered at the household level are presented in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Proposition 2, which predicted that the likelihood of migrating increases with the primary earner's income, holds across all specifications. The effect was statistically significant with the exception of male-power couples in which the females earned more. This group represented only 0.7% of all the couples in Table 6, meaning that Proposition 2's prediction holds for the seven subgroups representing 99.3% of the couples. Proposition 3 states that the effect of the secondary earner's income may go in either direction and that when the effect is positive, it would always be smaller than the effect of the primary earner's income. We found support for this proposition empirically with the exception of male-power couples in which the females earned more. Evidence for significant estimates with regard to earnings in the separate regressions according to power type and female/male primary earner is a strong argument against any collinearity concerns.

To examine the influence of the primary and secondary earners' incomes on emigration, we calculated the elasticity of the migration with respect to the primary and secondary earners' incomes for the groups depicted in Table 6. The formula for elasticity in each group, omitting group-specific subscripts, is $\frac{dp_{ab}}{dw_i}\frac{w_i}{p_{ab}}$, in which $i \in \{a, b\}$. Here, w_a denotes the earnings of the primary earner and w_b denotes the earnings of the secondary earner. Earnings w_a and w_b are components of vector $\mathbf{x}$ for the explanatory variables, which also

includes dummy variables for the age of the female, age of the male, age of the oldest child and year. $p_{ab}=\Phi_{ab}(\overline{x}\beta)$ is the probability of emigration as a function of the log earnings and other explanatory variables (see footnote 10 for details). The elasticities are calculated as the average values for each of the eight groups and are depicted in Figure 5.
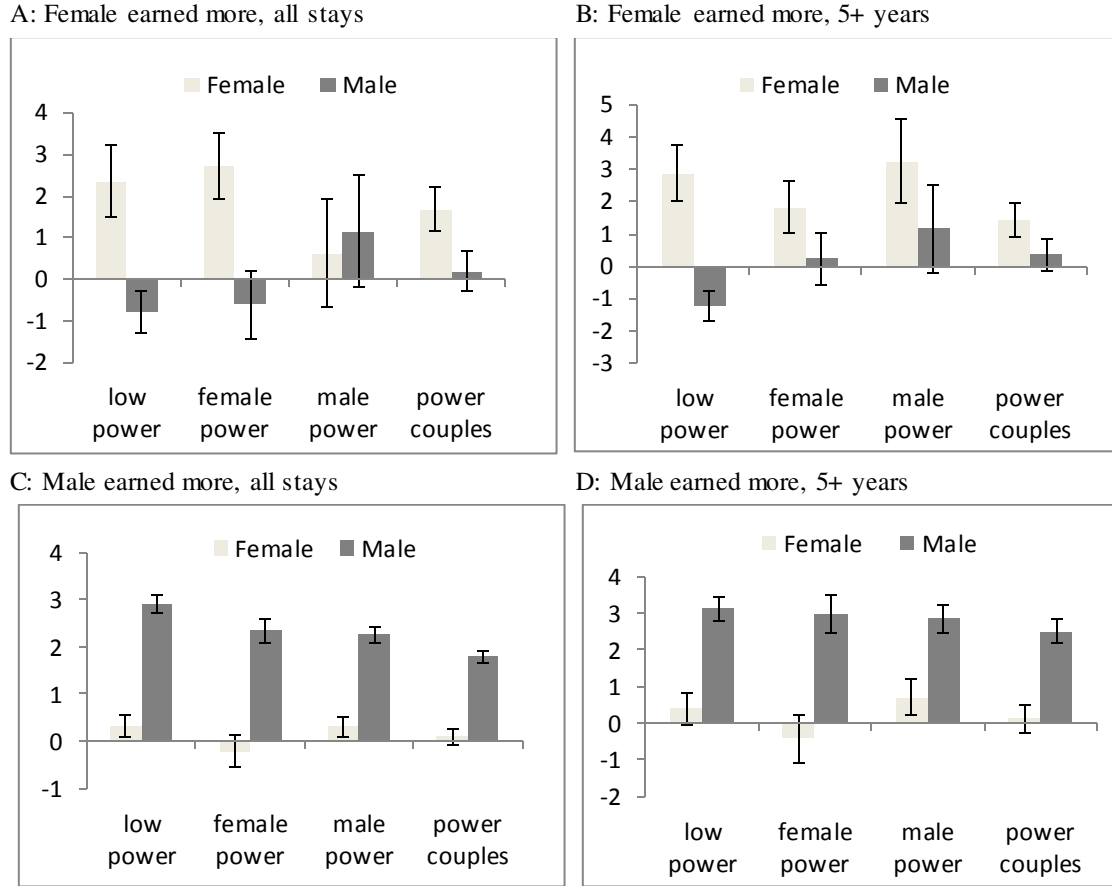

FIG. 5. – The elasticity of migration for couples with respect to incomes. The results are presented as elasticity with 95% confidence intervals, which are estimated at the average ages and incomes within the groups for which the elasticity is calculated. Women and men are between 25 to 37 years of age. Emigration years are 1982 to 2010 in panels A and C, and 1982 to 2005 in panels B and D. The probability of emigration was estimated based on the earnings during the previous year including only the couples in which both partners worked at least 60% of the full working time.

When analyzing across all emigration events (i.e., panels A and C), the probability that a couple will emigrate increases strongly with the primary earner's income, with the exception of a small group of male-power couples in which the females earn more. With respect

to the other groups, the elasticity ranges between 1.69 and 2.73 for the couples with a female primary earner, and between 1.78 and 2.91 for the couples with a male primary earner. The elasticities are larger when the focus is restricted to long stays, ranging between 1.44 and 3.26 for groups with a female primary earner, and 2.50 and 3.11 for groups with a male primary earner. These elasticities are considerably larger than those for single persons (see Figure 4). The elasticity of migration for five or more years with respect to the primary earner's income is always larger than the elasticity of migration for five or more years with respect to the secondary earner's income, which is consistent with Proposition 3. When short stays are included, this result holds for the other groups, with the exception of the 0.7% of couples in which only the male is college educated but the female earned more.

Proposition 5 assumes that migration costs are the same for both partners and predicted that the elasticity of migration for a couple with respect to the primary earner's home-country wage is always larger than the elasticity of migration for the primary earner with respect to his/her home-country wage as a single person, with the opposite pattern holding for secondary earners. Given that migration costs may depend on education and the presence of children, we compared the elasticities between single persons and primary and secondary earners in low-power couples and power couples, restricting the analysis to couples and single persons without children. The elasticities are calculated at the average income levels of the single persons who are the same gender and have identical levels of education. For couples, the average ages and earnings are used for the partners, which are calculated for each power type separately for those couples with female and male primary earners. The elasticities and test statistics, as well as the associated p-values, are presented in Table 7. The test statistics utilized the approximations for large samples $\frac{el_1 - el_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \xrightarrow{d} Z \sim N(0,1)$ (see

Bain and Engelhardt 1992, p. 380).

TABLE 7: ELASTICITY OF MIGRATION AMONG SINGLE PERSONS AND COUPLES

	College	Single	Primary earner	Z	p-value
Panel A: Single persons vs. primary earners, all stays					
Female	No	0.14	2.15	9.24	0.00
	Yes	0.61	1.84	6.40	0.00
Male	No	0.59	2.42	28.97	0.00
	Yes	0.87	2.04	17.32	0.00
Panel B: Single persons vs. primary earners, 5+ years					
	College	Single	Primary earner	Z	p-value
Female	No	0.49	2.29	4.18	0.00
	Yes	0.90	2.10	2.95	0.00
Male	No	1.00	2.87	14.52	0.00
	Yes	1.10	2.59	10.45	0.00
Panel C: Single persons vs. secondary earners, all stays					
	College	Single	Secondary earner	Z	p-value
Female	No	0.14	0.15	-0.03	0.51
	Yes	0.61	0.12	6.53	0.00
Male	No	0.59	-0.19	4.25	0.00
	Yes	0.87	-0.17	6.38	0.00
Panel D: Single persons vs. secondary earners, 5+ years					
	College	Single	Secondary earner	Z	p-value
Female	No	0.49	0.24	1.61	0.05
	Yes	0.90	0.22	4.12	0.00
Male	No	1.00	-0.35	3.94	0.00
	Yes	1.10	-0.32	4.51	0.00

Notes: The elasticities of migration are calculated on each line at the average income levels of the single persons. For each group, the elasticity is calculated at the average age. H_0 is in panels A and B such that the elasticity for the single persons was greater than or equal to the elasticity for the primary earners in the couples. H_0 is presented in panels C and D such that the elasticity for the single person is less than or equal to the elasticity for the secondary earners in the couples. Z denotes the test statistics for the differences in elasticities and p-values for the confidence levels at which H_0 could be rejected.

In summary, we found that the elasticity of migration among Danish single persons with respect to their income was clearly *less than* the elasticity of migration among the top income earners who immigrated to Denmark, as reported by Kleven et al. (2014), whereas the elasticity of migration among Danish couples with respect to the primary earner's income is *larger* than the elasticity of migration among the top income earners who immigrate to Denmark. The elasticity of migration with respect to the secondary earner's income is always smaller than the elasticity with respect to the single's income when the analyses focus on emigrating for five years or more. When shorter stays are included, this difference is evident for men and college-educated women, but not for women without college educations.

Why is the elasticity of couple migration with respect to the primary earner's income so large? Our conjecture is that it reflects the colocation problem and the need for intra-family compensating transfers. Costa and Kahn (2000) showed that the colocation problem plays a major role in American power couples as these couples increasingly chose to live in large metropolitan areas. The colocation problem may be even more severe with regard to international migration. When one partner is a tied mover, the gains for the partner who has a strong preference toward migration must be sufficient to compensate the tied mover. Given that the probability of emigration increases strongly with the primary earner's income, migration decisions may be made in the interest of the primary earner regardless of whether the earner is male or female. If migration decisions were more heavily influenced by the male's job opportunities, then we would expect the elasticity with regard to the male's income to always be positive, which is not the case.

To test the importance of our division of couples according to the primary earner's gender, we calculated the elasticity of migration with respect to the male and female incomes and did not separately analyze couples with male and female primary earners. In this context, the elasticities were similar to those observed for those couples with males as the primary earners.

C. All couples

Up to this section, our analysis has focused on dual-earner couples. Although this group is best suited to test our theory, approximately half of the couples satisfying our age restriction do not satisfy these criteria. Therefore, we extend the analysis to include these couples.

The first two columns of Table 8 explain the decision to emigrate according to male and female education levels, number of children, age of the female, age of the male, and age of the oldest child. The main focus here is on estimating the effect of the male and female education levels. The third and fourth columns add labor market status and earnings. When annual earnings are less than DKK 1, the log of the earnings is replaced with a zero, which allows us to keep in the analysis couples with a partner who stays at home and earns no income. The first and third columns analyze the couples in which the female earned more and the second and fourth columns analyze the couples in which the male earned more.

The effects of male and female's education levels are consistent with the results for dual-earner couples. The power couples are most likely to emigrate and the low-power couples least likely to emigrate, as suggested by Proposition 4. Couples with children are less mobile, and couples in which either partner is a student are more mobile. Notably, the effects of unemployment relative to being employed arise only for couples in which the male earns more. In these couples, the male being unemployed increases the likelihood of emigration and the female being unemployed reduces this likelihood. The most surprising finding is that the likelihood of emigration increases with the male's income and decreases with the female's income, regardless of whether the male or female earns more. However, only the effect of the male primary earner's income is large in its absolute value. Given that our theoretical model only analyzes dual-earner couples, this finding should not be understood to refute the model. This finding highlights that the relatively gender-neutral emigration pattern of the dual-earner couples with respect to the primary and secondary earners' incomes is replaced by a more male-centered pattern in couples in which at least one of the partners (typically the female) does not fulfill the requirement of working at least 60% of the full working time.

TABLE 8: PROBIT REGRESSION FOR FAMILY EMIGRATION

		Female earned more	Male earned more	Female earned more	Male earned more
Intercept		-3.19***	-3.13***	-2.99***	-6.19***
		(0.06)	(0.03)	(0.14)	(0.18)
Power couples		0.51***	0.58***	0.49***	0.55***
		(0.02)	(0.01)	(0.02)	(0.01)
Female-power couples		0.21***	0.22***	0.20***	0.21***
		(0.02)	(0.01)	(0.02)	(0.01)
Male-power couples		0.36***	0.49***	0.35***	0.45***
		(0.02)	(0.01)	(0.02)	(0.01)
[Low-power couples]					
Number of children	1	-0.39**	-0.43***	-0.40**	-0.40***
		(0.20)	(0.08)	(0.20)	(0.08)
	2	-0.34*	-0.37***	-0.36*	-0.35***
		(0.20)	(0.08)	(0.20)	(0.08)
	3+	-0.29	-0.31***	-0.29	-0.29***
		(0.20)	(0.08)	(0.20)	(0.08)
	[0]				
Female occupation	OLF			-0.01	0.01
				(0.05)	(0.02)
	Student			0.07	0.15***
				(0.05)	(0.02)
	Unem-ployed			-0.02	-0.03**
				(0.04)	(0.01)
	[Work]				
Male occupation	OLF			0.15***	0.32***
				(0.03)	(0.05)
	Student			0.16***	0.55***
				(0.03)	(0.04)
	Unem-ployed			-0.02	0.10***
				(0.03)	(0.03)
	[Work]				
Female log earnings				-0.02**	-0.01***
				(0.01)	(0.00)
Male log earnings				0.01***	0.24***
				(0.00)	(0.01)
Observations		1,277,941	4,607,220	1,277,941	4,607,220

Notes: Dummy variables for the age of the female, age of the male, age of the oldest child and year are included in all the models. OLF is an abbreviation for out of the labor force. When annual earnings are less than DKK 1, the log of the earnings is replaced with a zero. Robust standard errors clustered at the household level are presented in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

VI. Couple Migration and the Roy-Borjas Model

An important concern related to the generalizability of our results to other countries is that Denmark enjoys equal income distribution. Given that Borjas (1987) established that emigrants tend to be positively (negatively) selected from countries with more (less) equal income distribution than the destination country, we expect emigrants from Denmark to be positively selected. To test whether our results are maintained regardless of the differences in returns to skill, we ran our probit regressions separately for different destinations. Other Nordic countries have relatively small wage differences that are similar to Denmark, meaning that they provide the best test case for our theoretical model. English-speaking countries constitute an interesting group to study for two reasons. First, they all have wider wage differentials than Denmark. Second, Danes generally speak English very well, meaning that it is unlikely that either partner would be unable to work in one of these countries due to language difficulties. Therefore, English-speaking countries are an ideal subgroup to test our model because they allow for differences in the returns to skill between the home country and the destination country. Finally, the rest of the world generally has wider income differences than Denmark and other Nordic countries, but it is also likely that partners differ in their language skills, suggesting that a tied mover may have to stay at home.

Another concern is that the self-selection that we observe could be at least partly driven by immigration rules in destination countries. This problem does not arise in other Nordic countries because there is free migration between these countries and Denmark. To test the effects of immigration rules, we divided the English-speaking countries into the United Kingdom and Ireland on one hand, and the United States, Canada, Australia and New Zealand on the other. Danes can migrate freely to the United Kingdom and Ireland because of joint membership in the European Union. The United States, Canada, Australia and New Zealand need not admit everyone who wants to migrate from Denmark. Furthermore, visa rules in the latter group of countries may prevent the accompanying spouse from working. Restricting our focus to English-speaking countries allows us to exclude the risk that destination choices regarding countries with different immigration rules could be driven by the language skills of potential migrants. The prior literature regarding international migration in the absence of visa restrictions has primarily focused on migration to the United States during the age of mass migration before the First World War, yet this literature has not accounted for couple migration (see Abramitzky et al. 2012; 2014; Bandiera et al. 2013).

The elasticity of migration to different destinations with respect to female and male earnings is presented in Table 9. The elasticities are derived using similar specifications as in

Table 4 and then estimated as in Figure 5. Importantly, the qualitative effects of the other explanatory variables are included in all the regressions presented in Table 9 as in Table 4. Regardless of whether all the migration periods or only the migration periods that lasted five years or more are analyzed, the power couples and male-power couples were the most likely to emigrate to all the destinations, in analyses of both couples in which the male earns more and in which the female earns more. The number of emigrating couples in each subgroup is presented in Table A.4.

TABLE 9: THE ELASTICITY OF MIGRATION WITH RESPECT TO EARNINGS FOR DUAL-EARNER COUPLES WHEN MIGRATING TO DIFFERENT DESTINATIONS

	Female earned more	Male earned more	Female earned more, 5+ years abroad	Male earned more, 5+ years abroad
Other Nordic countries				
Female earnings	0.707	-0.116*	0.306	0.103
	[0.448]	[0.134]	[0.689]	[0.287]
Male earnings	-0.611***	1.719***	-0.853***	1.829***
	[0.182]	[0.120]	[0.244]	[0.223]
UK and Ireland				
Female earnings	2.268***	0.512***	1.430	0.868***
	[0. 665]	[0.146]	[1.673]	[0.336]
Male earnings	0.940	3.026***	1.028	3.551***
	[0.745]	[0.123]	[1.376]	[0.221]
US, CA, AU, NZ				
Female earnings	2.585***	0.251**	4.352***	0.578**
	[0.388]	[0.122]	[0.761]	[0.276]
Male earnings	-0.260	2.304***	-0.744*	2.579***
	[0.377]	[0.092]	[0.445]	[0.209]
Rest of the world				
Female earnings	2.254***	0.115	2.637***	0.060
	[0.296]	[0.076]	[0.706]	[0.173]
Male earnings	-0.008	2.257***	0.785	3.024***
	[0.330]	[0.062]	[0.909]	[0.123]

Notes: In each column, we report the estimated elasticity of migration for a dual-earner couple with respect to female income and male income for each destination. The elasticities are estimated as the average ages and incomes within the groups for which the elasticity is calculated for each country group listed above the cells, and for the groups of couples specified in each column. The coefficients that underlie the elasticities are derived from regressions that include the power

type and number of children as additional explanatory variables, and dummy variables for the age of the female, age of the male, age of the oldest child and year – as in Table 4. Full regression tables are available upon request. In each probit regression, the couples migrating to any other destination are excluded. Robust standard errors clustered at the household level are presented in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

The results presented in Table 9 are consistent with both the Roy-Borjas model (Roy 1951; Borjas 1987) and our theoretical model. In line with the theoretical predictions in Borjas (1987), we find that the emigrants are more strongly positively selected with regard to income for the English-speaking countries and the rest of the world than for the other Nordic countries. This finding holds for both the primary and secondary earners regardless of whether the primary earner is male or female. In line with our theoretical model, the elasticity of migration with respect to the primary earner's income is always positive, whereas the elasticity of migration with respect to the secondary earner's income varies with respect to its sign and is always smaller than the elasticity with respect to the primary earner's income. This finding suggests that emigration is driven by the primary earner's job opportunities both with respect to migration to the other Nordic countries with relatively similar returns to skill as Denmark (although the positive elasticity with respect to the female primary earner's income is not statistically significant) and with respect to migration to the English-speaking countries and the rest of the world. The colocation problem associated with family ties plays an important role in international migration also in the absence of skill price differences.

Elasticity with respect to the secondary earner's income is always larger for the United Kingdom and Ireland than for the United States, Canada, Australia and New Zealand, which may reflect the fact that visa rules in the latter group prevent accompanying spouses from working. Nonetheless, the elasticity with respect to the primary earner's income is of similar magnitude and is larger for male primary earners when migrating to the United Kingdom and Ireland and for female primary earners when migrating to the United States, Canada, Australia and New Zealand. Therefore, our central finding that primary earners in couples are more strongly self-selected than single persons does not appear to be driven by immigration restrictions.

VII. Conclusion

In this article, we first presented a theoretical model regarding the emigration of dual-earner couples and then we tested it using register data for the entire Danish population. Our theo-

retical model predicted that the probability of emigration would increase with the primary earner's income, whereas the effect of the secondary earner's income may operate in either direction. The empirical results were broadly consistent with this prediction regardless of whether the couples had children and whether the male or female is the primary earner. If migration decisions were more responsive to male job opportunities, as suggested by the previous literature regarding internal migration, then we would expect the elasticity with regard to the male's income to always be positive, which is not the case.

We found that the elasticity of the probability that a couple emigrates with respect to the primary earner's income is surprisingly large and considerably larger than the elasticity of the probability of emigration with respect to the income for single persons, which suggests that emigrating primary earners in couples are more strongly positively selected than emigrating single persons. This result is novel and counter to the intuition that family ties weaken self-selection due to an imperfect correlation in the earnings potential between the partners (see Borjas and Bronars 1991). Our intuition is that the colocation problem is a barrier for couples wanting to emigrate. When one partner cannot find a good job abroad, the other partner must have sufficient gains to compensate the tied mover. The likelihood of gaining enough to afford this situation is evident with increases in pre-migration income. The effects of the secondary earner's income are generally small. Importantly, our theoretical model predicts that the elasticity of migration with respect to the primary (secondary) earner's pre-emigration income is larger (smaller) in couples than it would be for the primary (secondary) earner as a single person, which is consistent with our findings. A strong self-selection in primary earners within couples is associated with couples having a lower probability of emigration than single persons.

To test whether our findings are driven by Denmark having a relatively equal income distribution, we analyzed migration to other Nordic countries, English-speaking countries and the rest of the world separately. The probability of emigration increases with the primary earner's income for each destination group, although the point estimate for the pre-migration earnings for the female primary earners was not statistically significant with respect to migration to the other Nordic countries. The positive effect of home-country income is stronger for the English-speaking countries and the rest of the world than for the other Nordic countries, which is consistent with previous results concerning skill price difference by Borjas (1987) and Grogger and Hanson (2011). Therefore, both rewards to skill and couple dynamics play important roles in the self-selection of migrants. Future research should test our theory of migration with countries that have wider income differences, as well as migration from less gender-equal countries. A separate analysis of the English-

speaking destination countries both in the European Union and outside of it suggests that our results are not driven by immigration rules in the destination countries. The predictions of our theory are satisfied for both groups of destination countries.

We also found that couples are most likely to emigrate when both partners have college degrees. The male's education plays a bigger role than the female's education in emigration decisions regardless of which partner earned more in Denmark. Furthermore, the emigration rates for couples with male primary earners are considerably higher than those with female primary earners when the males had college educations, whereas these differences among couples in which the male does not have a college education are minor. We also analyzed all the couples without the restriction that both partners had to work and found that emigration increases more strongly in association with male education levels. The probability of emigration increases strongly with the male's income in couples with male primary earners, whereas the effects of both male and female incomes were small in couples with female primary earners. Taken together, our findings suggest a mixture of dual-earner couples emphasizing the primary earner's income regardless of the primary earner's gender, although the traditional male breadwinner model remains such that greater weight is placed on the male's education, at least for a significant subsample of couples.

Appendix A

Proof of Proposition 1

Assume that $c_a = c_b = c$. (i) $p_{ab}^{large} = \bar{x} - \frac{2c}{w_a} + \frac{w_b}{2w_a}(2\bar{x} - 1) < \bar{x} - \frac{c}{w_a} = p_a$. (ii) $p_{ab}^{small} = \bar{x}^2\left(1 + \frac{w_a}{2w_b} + \frac{w_b}{2w_a}\right) - \frac{2c}{w_b}\bar{x} - \frac{2c}{w_a}\bar{x} + \frac{2c^2}{w_a w_b}$. $p_{ab}^{small} < p_a$ can be rewritten as:

(A1) $\qquad \bar{x}^2\left(1 + \frac{w_a}{2w_b} + \frac{w_b}{2w_a}\right) - \frac{2c}{w_b}\bar{x} - \frac{2c}{w_a}\bar{x} + \frac{2c^2}{w_a w_b} < \bar{x} - \frac{c}{w_a}.$

Given that the definition (4) of wage differences is relatively small, it can be rewritten as

(A2) $\qquad w_a\bar{x} - 2c < (1 - \bar{x})w_b.$

Insert the next notation $w_a = \alpha w_b$ into (A1), which yields

(A3) $\qquad \bar{x}^2\left(1 + \frac{\alpha}{2} + \frac{1}{2\alpha}\right) - \frac{2c\bar{x}}{w_b} - \frac{2c\bar{x}}{\alpha w_b} + \frac{2c^2}{\alpha w_b^2} - \bar{x} + \frac{c}{\alpha w_b} < 0.$

A further manipulation gives

$$\frac{1}{2\alpha}\left[\bar{x}^2(\alpha^2 + 2\alpha + 1) - \frac{4\bar{x}c}{w_b}(1 + \alpha) + \frac{4c^2}{w_b^2} - 2\bar{x}\alpha + \frac{2c}{w_b}\right] < 0$$

$$\frac{1}{2\alpha}\left[\left(\frac{2c}{w_b} - \bar{x}(1+\alpha)\right)^2 - 2\bar{x}\alpha + \frac{2c}{w_b}\right] < 0$$

$$\frac{1}{2\alpha}\left[\left(\frac{2c}{w_b} - \bar{x}(1+\alpha)\right)^2 + \left(\frac{2c}{w_b} - \bar{x}(1+\alpha)\right) - \bar{x}(\alpha-1)\right] < 0.$$

Introducing an auxiliary variable $A = \frac{2c}{w_b} - \bar{x}(1+\alpha)$, the condition can be written as

(A4) $\qquad \frac{1}{2\alpha}\left(A(A+1) - \bar{x}(\alpha-1)\right) < 0.$

Observe that $A < \frac{2c}{w_b} - 2\bar{x} < 0$ as $\alpha > 1$ and $A + 1 = \frac{1}{w_b}[2c - w_b(\bar{x}(1+\alpha) - 1)] > 0$ by inequality (A2). Therefore, (A4) is satisfied, completing the proof.

Proof of Proposition 2

$$\frac{\partial p_{ab}^{small}}{\partial w_a} = \bar{x}^2\left(\frac{1}{2w_b} - \frac{w_b}{2w_a^2}\right) + \frac{c_a+c_b}{w_a^2}\bar{x} - \frac{(c_a+c_b)^2}{2w_a^2 w_b} = \frac{\bar{x}^2}{2w_b} - \frac{(w_b\bar{x} - c_a - c_b)^2}{2w_a^2 w_b}$$

$$> \frac{\bar{x}^2}{2w_b} - \frac{(w_b\bar{x})^2}{2w_a^2 w_b} = \frac{\bar{x}^2}{2w_b}\left(1 - \frac{w_b^2}{w_a^2}\right) > 0 \text{ and } \frac{\partial p_{ab}^{large}}{\partial w_a} = \frac{c_a+c_b}{w_a^2} + \frac{w_b}{2w_a^2}(1 - 2\bar{x}) > 0.$$

Proof of Proposition 3

With large wage differences, $\frac{\partial p_{ab}^{large}}{\partial w_b} = \frac{2\bar{x}-1}{2w_a} < 0$. With small wage differences,

$\frac{\partial p_{ab}^{small}}{\partial w_b} = \bar{x}^2\left(-\frac{w_a}{2w_b^2} + \frac{1}{2w_a}\right) + \frac{c_a+c_b}{w_b^2}\bar{x} - \frac{(c_a+c_b)^2}{2w_a w_b^2}$. To determine whether this result can be either positive or negative, assume first that $c_a = c_b = 0.1$, $\bar{x} = 0.4$ and $w_b = 1$. With $w_a = 1.4$, $\frac{\partial p_{ab}^{small}}{\partial w_b} > 0$ and $w_a = 1.6$, $\frac{\partial p_{ab}^{small}}{\partial w_b} < 0$, which completes the proof that the effect may go in either direction. With large income differences, an increase in the primary earner's income always increases the probability of emigration more than an increase in the secondary earner's income. To determine whether this also holds for small income differences, note that

$$\frac{\partial p_{ab}^{small}}{\partial w_a} - \frac{\partial p_{ab}^{small}}{\partial w_b} = \frac{\bar{x}^2}{2w_b} - \frac{\bar{x}^2 w_b^2 - 2\bar{x}w_b(c_a+c_b) + (c_a+c_b)^2}{2w_a^2 w_b} + \frac{\bar{x}^2 w_a}{2w_b^2} - \frac{\bar{x}^2}{2w_a} - \frac{(c_a+c_b)\bar{x}}{w_b^2} + \frac{(c_a+c_b)^2}{2w_a w_b^2} =$$

$$\frac{(w_a-w_b)[\bar{x}(w_a+w_b) - c_a - c_b]^2}{2w_a^2 w_b^2} > 0.$$

Proof of Proposition 4

$$\frac{\partial p_{ab}^{small}}{\partial c_a} = \frac{\partial p_{ab}^{small}}{\partial c_b} = -\frac{1}{w_b}\bar{x} - \frac{1}{w_a}\bar{x} + \frac{c_a+c_b}{w_a w_b} = \frac{1}{w_a}\left(\frac{c_b}{w_b} - \bar{x}\right) + \frac{1}{w_b}\left(\frac{c_a}{w_a} - \bar{x}\right) < 0 \text{ and}$$

$$\frac{\partial p_{ab}^{large}}{\partial c_a} = \frac{\partial p_{ab}^{large}}{\partial c_b} = -\frac{1}{w_a} < 0.$$

Proof of Proposition 5

Assume $c_a = c_b = c$ and until point (iii), and below that,$w_a > w_b$.The elasticity of migration of k, $k \in \{a, b\}$, as a single person would be $\frac{\partial p_k}{\partial w_k} \frac{w_k}{p_k} = \frac{c}{\bar{x} w_k - c}$. The elasticity of migration for a couple with respect to w_a is $\frac{\partial p_{ab}^{small}}{\partial w_a} \frac{w_a}{p_{ab}^{small}} = \frac{\bar{x}^2 \left(\frac{w_a}{2w_b} - \frac{w_b}{2w_a} \right) + \frac{2c}{w_a} \bar{x} - \frac{2c^2}{w_a w_b}}{\bar{x}^2 \left(1 + \frac{w_a}{2w_b} + \frac{w_b}{2w_a} \right) - \frac{2c}{w_b} \bar{x} - \frac{2c}{w_a} \bar{x} + \frac{2c^2}{w_a w_b}}$ with a small wage difference and $\frac{\partial p_{ab}^{large}}{\partial w_a} \frac{w_a}{p_{ab}^{large}} = \frac{\frac{2c}{w_a} + \frac{w_b}{2w_a} (1 - 2\bar{x})}{\bar{x} - \frac{2c}{w_a} + \frac{w_b}{2w_a} (2\bar{x} - 1)}$ with a large wage difference. The elasticity of migration for a couple with respect to w_b is $\frac{\partial p_{ab}^{small}}{\partial w_b} \frac{w_b}{p_{ab}^{small}} = \frac{\bar{x}^2 \left(-\frac{w_a}{2w_b} + \frac{w_b}{2w_a} \right) + \frac{2c}{w_b} \bar{x} - \frac{2c^2}{w_a w_b}}{\bar{x}^2 \left(1 + \frac{w_a}{2w_b} + \frac{w_b}{2w_a} \right) - \frac{2c}{w_b} \bar{x} - \frac{2c}{w_a} \bar{x} + \frac{2c^2}{w_a w_b}}$ with a small wage difference.(i) For small wage differences, inserting the terms into $\frac{\partial p_{ab}^{small}}{\partial w_a} \frac{w_a}{p_{ab}^{small}} > \frac{\partial p_a}{\partial w_a} \frac{w_a}{p_a}$, multiplying both sides by denominators and simplifying yields $\bar{x}^3 \left(\frac{w_a^2}{2w_b} - \frac{w_b}{2} \right) + c\bar{x}^2 \left(1 - \frac{w_a}{w_b} \right) > 0$. This holds whenever $w_a > w_b$. Inserting the terms into $\frac{\partial p_{ab}^{small}}{\partial w_b} \frac{w_b}{p_{ab}^{small}} > \frac{\partial p_b}{\partial w_b} \frac{w_b}{p_b}$, multiplying both sides by denominators and simplifying yields $\bar{x}^3 \left(\frac{w_b^2}{2w_a} - \frac{w_a}{2} \right) + c\bar{x}^2 \left(1 - \frac{w_b}{w_a} \right) < 0$. Multiplying both sides by $\frac{2w_a}{\bar{x}^2}$ and dividing by $(w_a - w_b)$ yields $-\bar{x}(w_a + w_b) + 2c < 0$, which always holds. (ii) For large wage differences, inserting the terms into $\frac{\partial p_{ab}^{large}}{\partial w_a} \frac{w_a}{p_{ab}^{large}} > \frac{\partial p_a}{\partial w_a} \frac{w_a}{p_a}$, multiplying both sides by denominators and simplifying yields $\bar{x}c + \frac{\bar{x}w_b}{2} (1 - 2\bar{x}) > 0$, which holds always. Given that the $\frac{\partial p_{ab}^{small}}{\partial w_b} < 0$ according to Proposition 3, the claim $\frac{\partial p_{ab}^{large}}{\partial w_b} \frac{w_b}{p_{ab}^{large}} < \frac{\partial p_b}{\partial w_b} \frac{w_b}{p_b}$ holds automatically. (iii) Assume that $w_a = w_b$. Inserting this shows that $\frac{\partial p_{ab}^{small}}{\partial w_a} \frac{w_a}{p_{ab}^{small}} = \frac{\partial p_a}{\partial w_a} \frac{w_a}{p_a} = \frac{\partial p_{ab}^{small}}{\partial w_b} \frac{w_b}{p_{ab}^{small}} = \frac{\partial p_b}{\partial w_b} \frac{w_b}{p_b}$.

Appendix B

		Panel A: Emigration rates of married couples	
		Male education	
		Low	High
Female	Low	0.10	0.47
education	High	0.21	0.63

TABLE A.2: LONG-TERM EMIGRATION RATES OF COUPLES

		Panel A: Emigration rates for 5+ years (in percentages) according to education	
		Male education	
		Low	High
Female	Low	0.03	0.11
education	High	0.05	0.12
		Panel B: Emigration rates for 5+ years when the female earned more	
		Male	
		Low	High
Female	Low	0.03	0.08
education	High	0.04	0.09
		Panel C: Emigration rates for 5+ years when the male earned more	
		Male	
		Low	High
Female	Low	0.03	0.12
education	High	0.05	0.13

Note: Only couples in which neither partner returned to Denmark within five years are counted as long-term emigrants.

TABLE A.3: THE NUMBER OF EMIGRATING COUPLES

	Low-power	Female-power	Male-power	Power
Female earned more	204	167	79	400
Male earned more	1,428	665	1,253	2,634

TABLE A.4: THE NUMBER OF EMIGRATING COUPLES

	Female earned more	Male earned more	Female earned more, 5+ years abroad	Male earned more, 5+ years abroad
Other Nordic countries	171	889	131	719
UK and Ireland	79	734	69	673
US, CA, AU, NZ	178	1,231	144	1,036
Rest of the world	422	3,126	365	2,739

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